Space Weather Technical Forecast

Issued on Thursday, 22 February 2024 at 01:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Ongoing chance of Moderate solar activity with a slight chance of X-class flares.

Solar Activity: Solar activity has been High, with an impulsive X1.8 flare peaking at 21/2307UTC from AR3590 in the northeast quadrant. This region has shown significant development as it has rotated across the northeastern limb, with a beta-gamma configuration and a potential delta spot forming in the central portion. AR3586 close to the north-centre disc is stable and simple. No further active regions are discernible on the visible disc, although returning region ex-AR3575 is just behind the southeastern limb and is expected to rotate onto the Earth-facing side of the Sun through the next two days.

A large filament has been observed leaving the northwest of the disc around 21/1730UTC and will be analysed once sufficient imagery is available.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE have been at ambient speed throughout, but showed a step change from 275km/s to 350km/s at around 21/0600UTC which appears to be due to a weak and undiagnosed coronal hole. Density has been below average through the period. Total magnetic field strength has weakened from around 9nT to 5nT with the initial enhancement again likely due to the possible weak coronal hole connection. The north-south component has only varied weakly. Phi angle was firmly positive (away from the Sun). Geomagnetic activity was mainly Quiet, with one Unsettled interval at the start of the period.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was just above normal background levels but well below the S1/Minor Radiation Storm threshold. Electron flux (greater than 2MeV) observed at GOES16 has been at normal background levels, with electron fluence well below the Active (1e8 integrated pfu) threshold. The observed 24-hour fluence at 22/0001UTC was 1.05e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Low to Moderate activity is forecast with a slight chance of High activity, mainly from AR3590, but also potentially from ex-AR3575.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are forecast over the next four days, although one filament eruption will be analysed and may potentially affect the Earth. Solar winds are ambient, but may reach 450-500km/s either later on 24 or during 25 February due to a forecast connection with the high speed stream from coronal hole 01. Geomagnetic activity is forecast to be mainly Quiet with isolated Unsettled intervals, with an increased risk of Active intervals due to the possible onset of the high speed stream. G1/Minor Storm intervals are also possible, but not considered likely.

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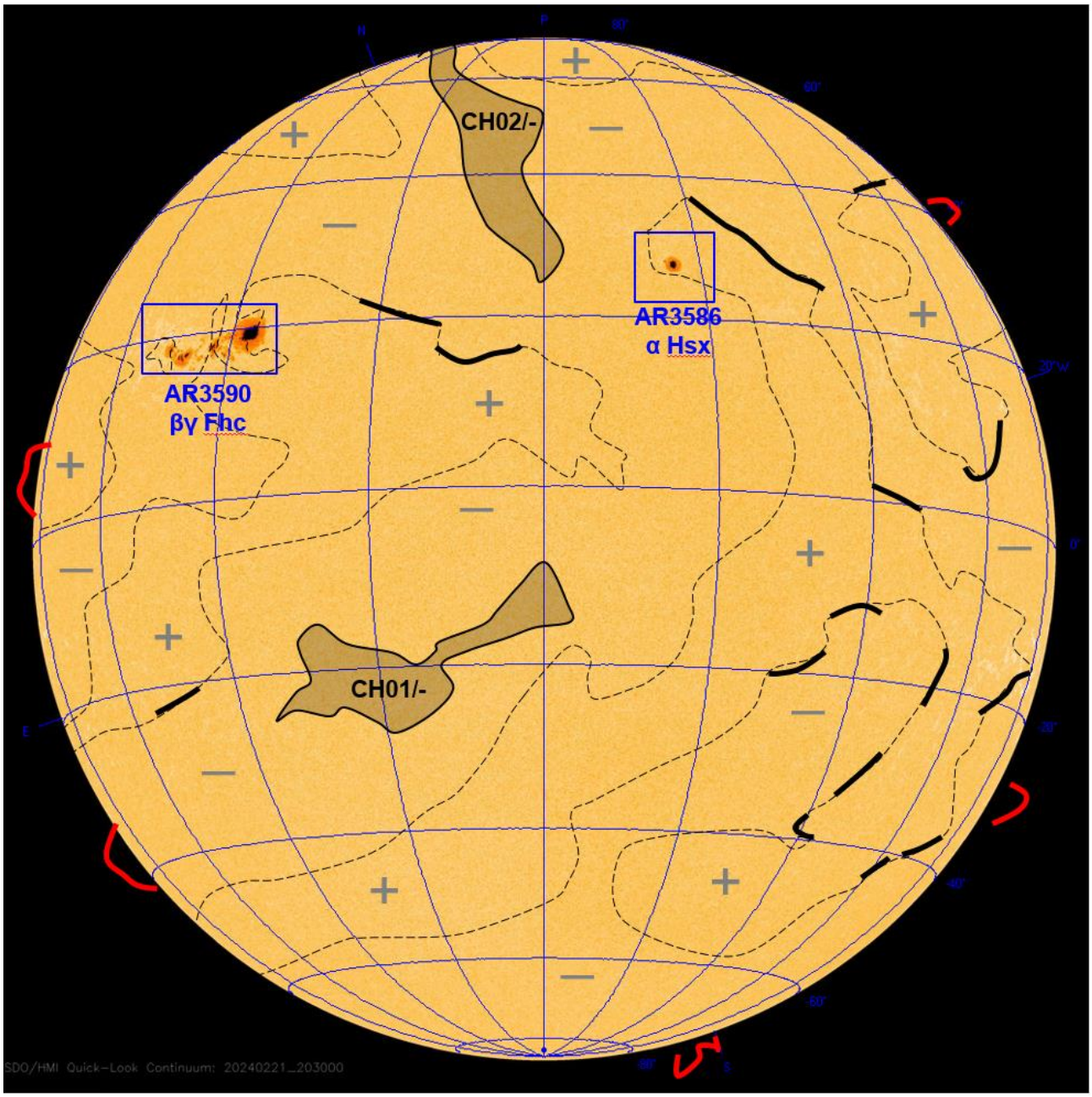
Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux is expected to continue to gradually ease towards resting background levels, with a very low risk of an increase during this period due to energetic flares from AR3590.

High energy electron flux (greater than 2MeV) is expected to remain at normal background levels. 24-hour electron fluence is expected to stay below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 21/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs are forecast, although a filament eruption from the northwest quadrant will be analysed once sufficient imagery becomes available.

A weak high speed stream appears to be affecting the Earth, likely from an undiagnosed high speed stream. The speed of the high speed stream is only 350km/s which is only slightly above background values. A further high speed stream from coronal hole 01 may then connect with Earth, either late on 24 or during 25 February. This feature reached close to 500km/s on the last rotation, but appears smaller and weaker on this rotation so speeds of 450-500km/s are considered most likely.

Geomagnetic activity is forecast to be mainly Quiet with isolated Unsettled intervals. Active intervals are then considered possible due to the onset of the high speed stream on 24 and 25 February. A maximum of Active was observed on the last rotation, so G1/Minor Storms are considered unlikely, even with negative coronal hole considered to be more favourable for a strong connection close to the March equinox.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Filament eruption, circled and LASCO C3 imagery, showing the filament eruption which is awaiting analysis

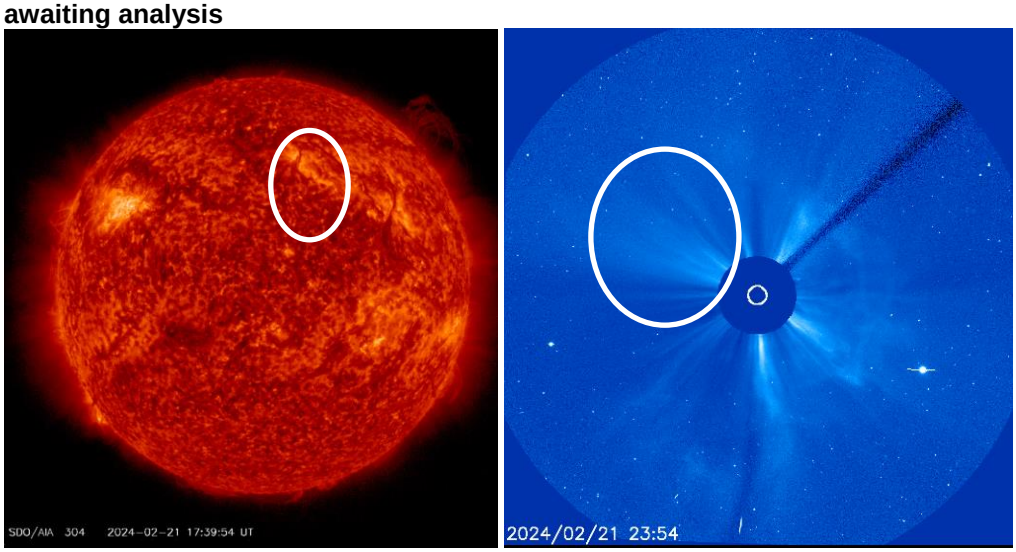

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Figure 3: L1 ACE solar wind observations

Radio Blackouts - X-Ray Flares:

Solar activity has been High, with a X1.8 flare observed from AR3590 in the northeast quadrant. This is a large region, which has been becoming increasingly magnetic complex as it has rotated across the disc. There are indications of a potential delta spot in the centre of this region, and the recent flare supports this observation of increased complexity. AR3586 is the only other region visible, but this is simple and stable. AR3583 rotated across the limb a number of days ago and the risk from this region has become negligible. Ex-AR3575 is expected to return across the southeast limb through the next two days and has already exhibited significant activity on the farside with a number of large CMEs.

Activity is forecast to be mainly Low or Moderate, with a slight chance of further X-class flares. The risk is forecast to increase through the period as ex-AR3575 rotates onto the visible side of the disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	50	60	60
Very Active	R3 to R5 X Class	Yes	20	20	20	20

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Figure 4: SDO AIA 94 showing the X1.8 flare from AR3590 at 21/2305UTC

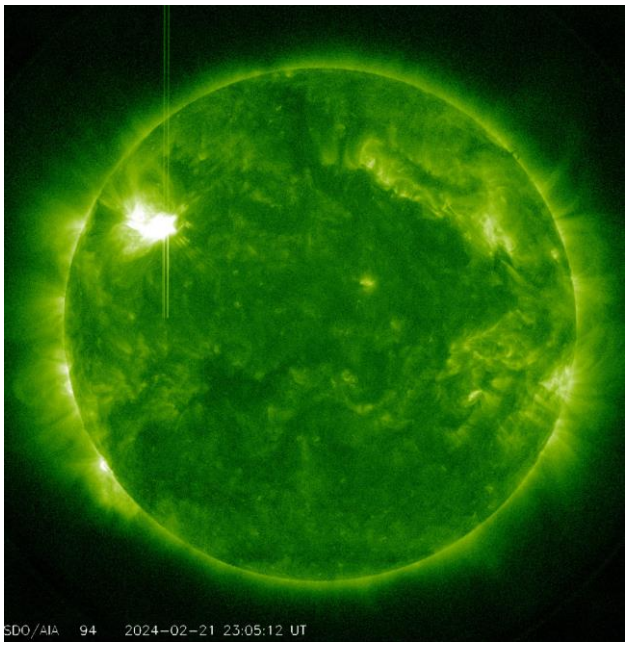

Figure 5: SDO HMI intensitygram and magnetogram imagery from AR3590 (Fhc/βγ), with the potential developing delta spot circled.

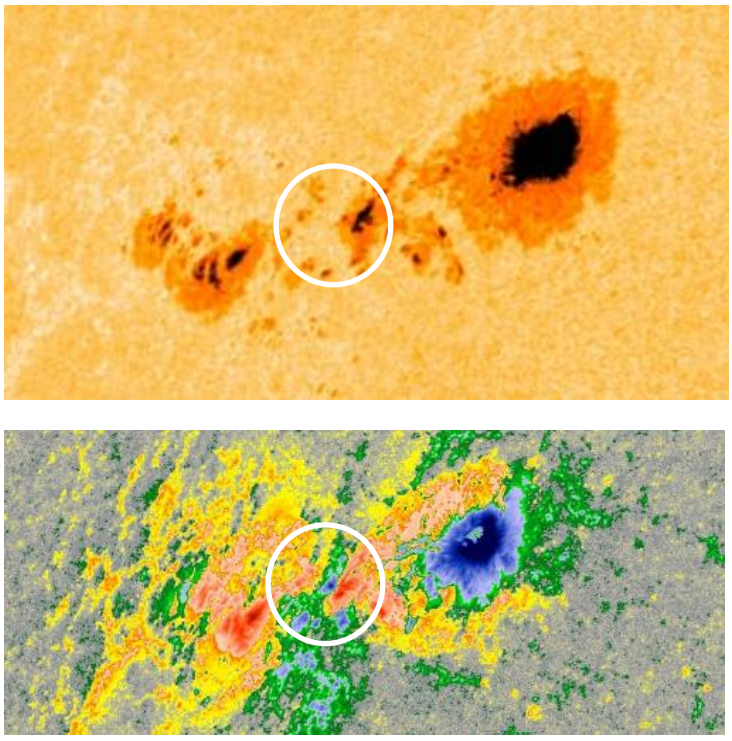

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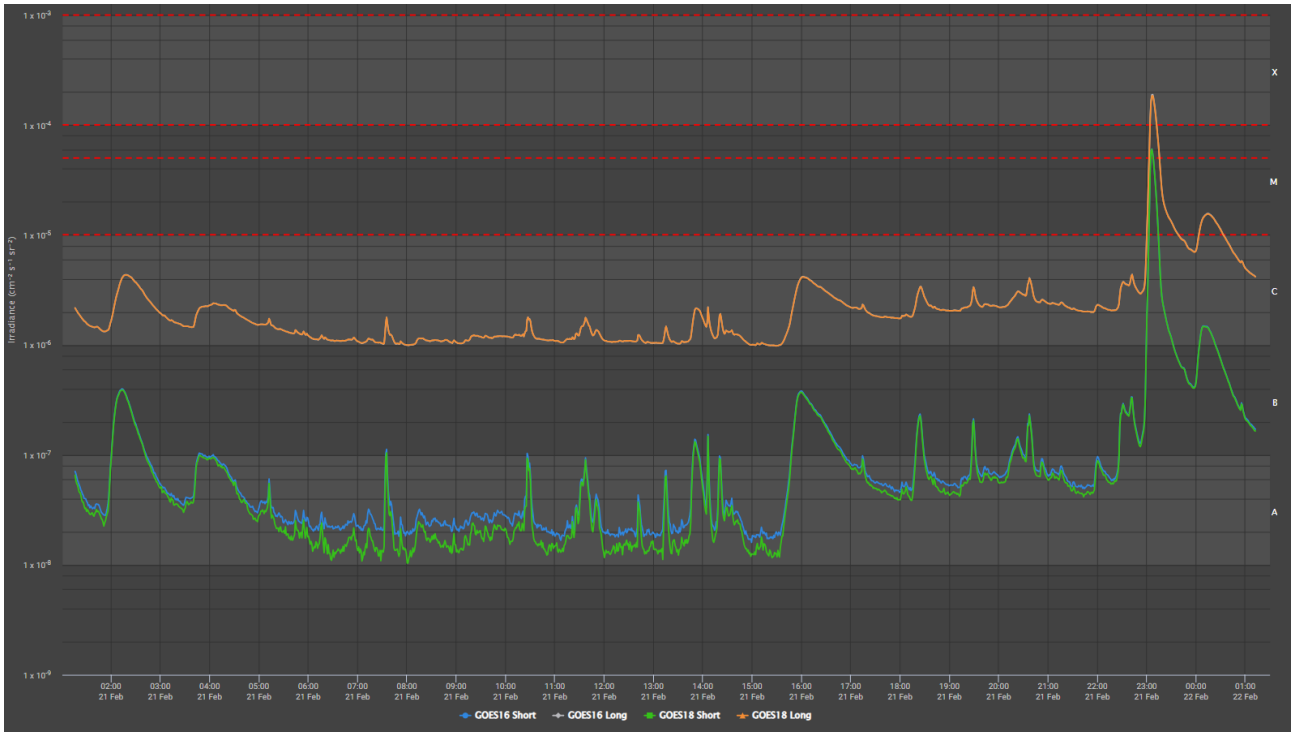
Figure 6: GOES 16 X-ray flux



Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) protons are continuing to edge towards background levels, but currently remain slightly elevated above normal background.

There are no significant sources of radiation storms in the western hemisphere, but a X-class flare from AR3590 suggests that this could be an increasing source of proton storms as the region moves towards and beyond centre disc through the forecast period. Ex-AR3575 is due to rotate onto the visible disc through the period and will present a risk of proton storms, albeit limited due to the likely position close to the southeast limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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Met Office Space Weather Technical Forecast

High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) is at background levels. There are no potential inputs into the radiation belts forecast through the next four days with mainly background levels expected.

Electron fluence values are expected to remain well below the Active threshold in the absence of any significant electron flux increases.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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